

# Improvement Proses Reduksi Katalis Melalui Penggunaan Gas Hidrogen Eksternal Sebagai Gas Pereduksi Terkait Penggantian Katalis Low Temperature Shift Converter (LTSC) di Unit Hydrogen Plant = Improvement of the Catalyst Reduction Process Through the Use of External Hydrogen Gas as Reducing Gas Related to Low Temperature Shift Converter (LTSC) Catalyst Replacement in Hydrogen Plant Unit

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## Abstrak

Hidrogen merupakan senyawa penting yang digunakan pada kilang minyak bumi terutama untuk menghasilkan produk dengan pengotor yang rendah dan kestabilan yang bagus. Hidrogen umumnya diproduksi oleh hydrogen plant melalui jalur steam reforming – shift converter – CO<sub>2</sub> removal. Pada Major Turn Around (TA) yang dilakukan setiap 5 (lima) tahun sekali, penulis diberikan tugas oleh General Manager suatu kilang untuk menjadi Leader pada proyek ini, yang bertanggungjawab dalam proses penggantian katalis di unit Hydrogen Plant. Perbedaan material dan karakteristik pada tiap katalis, serta perbedaan desain reaktor menjadi tantangan tersendiri dalam melaksanakan penggantian katalis. Meskipun demikian, laporan ini berfokus pada upaya perbaikan proses reduksi katalis Low Temperature Shift Converter (LTSC) supaya memperoleh proses reduksi yang stabil dan minim gangguan. Beberapa kendala berdasarkan pengalaman pada proses reduksi sebelumnya berhasil diidentifikasi dan menghasilkan beberapa alternatif solusi antara lain: (a) once-through menggunakan gas alam, (b) recycle menggunakan nitrogen dan dedicated facility, serta (c) recycle menggunakan hidrogen eksternal sebagai gas pereduksi. Alternatif solusi (c) dipilih berdasarkan aspek efektivitas, biaya, dan dampak lingkungan. Penggunaan hidrogen eksternal berhasil memperbaiki proses reduksi menjadi lebih stabil dan minim gangguan yang dapat dilihat dari profil temperatur bed katalis dan tidak terjadinya temperature runaway. Selain itu, durasi reduksi dapat dipangkas dari sebelumnya 6 hari menjadi 3 hari. Dalam menjalankan praktik keinsinyuran tersebut, penulis berpedoman pada peraturan perusahaan antara lain: Tata Kerja Organisasi Penyusunan Hazard Identification & Risk Assessment (No. B07-012), Pedoman pemilihan jenis dan pengadaan katalis untuk kilang (No. A-002), Tata Kerja Penggunaan Alat untuk pelaksanaan unloading dan loading katalis LTSC (No. D04-31), dan Tata Kerja Penggunaan Alat untuk pelaksanaan reduksi katalis LTSC (No. D04-027).

.....Hydrogen is an important substance used in petroleum refineries, especially to produce products with low impurities and good stability. Hydrogen is generally produced by hydrogen plants through steam reforming – shift converter – CO<sub>2</sub> removal pathways. On the Major Turn Around (TA) which is carried out every 5 (five) years, the author is given the task by General Manager of a refinery to become Leader of this project which is responsible for the catalyst replacement process in Hydrogen Plant unit. Differences in materials and characteristics of each catalyst, as well as differences in reactor design, become challenges in implementing catalyst replacement. However, this report focuses on efforts to improve the Low Temperature Shift Converter (LTSC) catalyst reduction process, in order to obtain a stable reduction process with minimal disruption. Several obstacles based on experience in previous reduction processes were identified and resulted in several alternative solutions, including: (a) once-through using natural gas, (b) recycling using nitrogen and a dedicated facility, and (c) recycling using external hydrogen as a reducing

gas. Alternative solution (c) is selected based on aspects of effectiveness, cost, and environmental impact. The use of external hydrogen succeeded in improving the reduction process to be more stable and with minimal disturbance which can be seen from the temperature profile of the catalyst bed and the absence of temperature runaway. In addition, the reduction duration can be cut from the previous 6 days to 3 days. The author is guided by company regulations in carrying out these engineering practices, including: Work Procedures for preparation of hazard identification & risk assessment (No. B07-012), Guidelines for selecting the type and procurement of catalysts for refineries (No. A-002), Work Procedures for carrying out unloading and loading of LTSC catalysts (No. D04-31), and Procedure for carrying out LTSC catalyst reduction (No. D04-027).